



# Arthropods of Canadian Grasslands

Number 9

2003

## Contents

Contributions welcome .....	inside front cover
Grasslands news:	
Focus sites .....	1
Websites disappear .....	1
Grasslands sampling residues .....	2
Grasslands project action	
Grasslands symposium 2002 .....	3
Grasslands volume in preparation .....	3
Grassland project key site 2003: Peace River grasslands .....	4
Slant-faced grasshoppers of the Canadian Prairies and northern Great Plains .....	5
Remnant Peace River grassland and disjunct butterflies .....	17
The effect of burn season on the spider fauna of tallgrass prairie .....	19
Factors affecting the community ecology of predacious diving beetles .....	22
Arthropod assemblages in cattle dung .....	24
Web watch: The Nature Conservancy of Canada and the Missouri Coteau .....	26
Human impact on the habitats of prairie insects .....	27

*Arthropods of Canadian Grasslands* supports the grasslands project of the Biological Survey of Canada (Terrestrial Arthropods) by providing information relevant to the study of grassland arthropods in Canada.

Unlike the vast majority of Canadian prairie ecosystems, Grasslands National Park (shown here) contains grasslands that have been grazed by cattle but not broken. Read more about the history of the grasslands and about Joe Shorthouse's quest to find and document a wide range of grassland insect habitats on page 27.





---

## Contributions welcome

Please consider submitting items to *Arthropods of Canadian Grasslands*



Grassland site descriptions



Current research – project reports



Short news items



Feature articles



Grassland species accounts



Selected publications

---

Contributions such as these, as well as other items of interest to students of grasslands and their arthropods, are welcomed by the editor. This publication (formerly *Newsletter*, *Arthropods of Canadian Grasslands*) appears annually in March; final copy deadline for the next issue is January 30, 2004.

**Editor:**

H.V. Danks  
Biological Survey of Canada (Terrestrial Arthropods)  
Canadian Museum of Nature  
P.O. Box 3443, Station “D”  
Ottawa, ON K1P 6P4  
613-566-4787 (tel.)  
613-364-4022 (fax)  
hdanks@mus-nature.ca

Articles without other accreditation are prepared by the Editor.

---

The website of the Biological Survey is at <http://www.biology.ualberta.ca/bsc/bschome.htm>



# Grasslands News

## Focus sites

The annual group field trip for 2003 will be in the Peace River grasslands in northwestern Alberta. More information on this July expedition is on p. 4.

A report that might be expected in this issue on the Survey's planned 2002 field trip to the

Tallgrass Prairie Preserve near Gardenton does not appear here. Heavy rainfall and flooding in southern Manitoba during June and early July rendered fieldwork all but impossible on terrestrial insects, and led to the cancellation of that operation planned for mid-July.

## Web sites disappear

The articles on grasshoppers in successive issues of this publication (see p. 5) were complemented until recently by a very informative web site, with text and visuals about past outbreaks, projections, frequently asked questions and other matters concerning grasshoppers. However, this site – although widely used with well over 30,000 hits per year – has been removed from the Lethbridge Research Station site pending revision and translation. Work is in progress to replace it with a smaller version that conforms to new guidelines.

Likewise, extensive information relevant to groups of arthropods that occur in grasslands and elsewhere has been removed from the web site associated with the Canadian National Collection of insects and arachnids at the Eastern Cereal and Oilseed Research Centre. These losses are considerable – as indicated by the number of major web pages listed in the box – including material about arthropods associated with dung (see p. 24).

### Entomology web products recently removed from the ECORC website

#### Diptera

- Diptera Types in the Canadian National Collection (Parts 1–4, suppl.)
- Fly Times newsletter
- Tachinid Times newsletter
- Directory of North American Dipterists
- Arthropods Associated with livestock dung in Canada (Filth fly pests, key to Diptera families associated with cow dung, feedlot Sarcophagidae in southern Alberta)
- Identification systems for biocontrol insects – Diptera
- Tachinid morphology
- Tachinid parasitoids of Bertha armyworm
- Tachinid bibliography (1980–present)
- Checklist of North American Tachinidae
- Update of tachinid names in Arnaud (1978)

#### Hymenoptera

- Illustrated key to chalcid parasitoids of filth flies in America North of Mexico
- Glossary of chalcid positional and morphological terms
- Bibliography of chalcid parasitoids of filth flies

- Chalcidoid parasitoids of Bertha armyworm
- Revision of Asaphes species from America North of Mexico (Chalcidoidea)
- Braconid parasitoids of Bertha armyworm and of Diamondback moth
- Chalcidoid parasitoids of Diamondback moth
- Chalcidoid parasitoids and hyperparasitoids of Choristoneura species

#### Coleoptera

- Beetles of Canada and Alaska
- Histerid Beetles associated with livestock dung in Canada
- Staphylinini rove beetles associated with livestock dung in Canada

#### Hemiptera

- Lygus bugs on the Canadian prairies

#### Acari

- Ticks and animal health in Canada
- Predatory mesostigmatic mites associated with filth flies in Canada

#### Miscellaneous

- Checklist of Canadian amber inclusions in the CNC



Changes to these and other web sites across the government system (some of which will not reappear for a very long time because of the costs, delays and feasibility of revision and translation), reflect adherence to Treasury Board's Common Look and Feel (CLF) Standards and Guidelines for the Internet. These policies are in place as of December 31, 2002 "to ensure sites can be easily accessed by the widest possible audience" (see [http://www.cio-dpi.gc.ca/clf-upe/a\\_e.asp](http://www.cio-dpi.gc.ca/clf-upe/a_e.asp)). Two of the many features affected are outlined below.

One standard requires that federal web sites have all material in html format (not just in pdf format, for example).

Also, use of official languages must follow the Official Languages Act (web site policy at [http://www.tbs-sct.gc.ca/pubs\\_pol/hrpubs/offlang/uolee.asp](http://www.tbs-sct.gc.ca/pubs_pol/hrpubs/offlang/uolee.asp)). Some key requirements of that policy are that an office designated as bilingual for service to the public must post, on its site on an external electronic network, information for the public

in English and French at the same time. The only material that can be posted in one official language is information clearly intended for an identified individual member of the public, or unchanged items from organizations not subject to the Official Languages Act. Furthermore, if hyperlinks on the site refer to texts intended as part of the bilingual office's service to the public, those texts also must be available in the official language of the user.

There is no exception for scientific material written in the language of the author if intended for internet use even by specialists. The relevant language policy ([http://www.tbs-sct.gc.ca/pubs\\_pol/hrpubs/offlang/chap1\\_1-1\\_e.asp#statement](http://www.tbs-sct.gc.ca/pubs_pol/hrpubs/offlang/chap1_1-1_e.asp#statement)) requires that if communication is directed to a specific public whose linguistic preferences are unknown, a federal institution designated as bilingual must either determine those preferences and ensure that each person receives the communication in the official language of choice, or provide the communication in both official languages.

## Grasslands sampling residues

The article in issue no. 7 of this newsletter about mining sampling residues (Wheeler 2001) prompted detailed consideration of the issue by some correspondents and members of the grasslands subcommittee. Needs for a more or less formal system were analysed and the costs of such a plan were then weighed against the potential benefits and problems.

A formal system requires facilities (e.g. freezer storage at several places that could act as regional nodes), supplies (e.g. alcohol, vials), transportation (e.g. shipping costs), labelling, and computer tracking (e.g. updating the database as material is removed). Standardization is desirable but is not realistic for some of these elements, for example storage conditions and vial sizes.

Such an analysis suggested that it is not feasible at the moment to launch any large and coordinated tracking program for sample residues.

Instead, it seems appropriate to allow a much more limited system to develop on an ad hoc basis. Such a system will be loosely coordinated through the Biological Survey secretariat as follows. The secretariat will make an effort to remain aware of potentially useful sample residues from grasslands sampling programs, typically relatively large and diverse collections especially from sites of particular interest. At the same time, anyone with specific interests can contact the secretariat to enquire whether material suitable for their needs is available.

To provide information about significant sample residues, or to determine if there are known residues that might meet particular requirements, please contact the secretariat (see inside front cover).

Wheeler, T.A. 2001. Buried treasure: mining the residues from grassland sampling programs. *Arthropods of Canadian Grasslands* 7: 13–14.



## Grasslands project action

### Grasslands Symposium 2002

A formal symposium entitled Arthropods of Canadian Grasslands: Ecology and Interactions in Grassland Habitats was held in conjunction with the Entomological Society of Canada Annual Meeting in Winnipeg on 8 October 2002. In keeping with the theme of the symposium, the speakers focused on grasslands as a habitat, with most talks examining arthropod species assemblages in a variety of grassland habitat types across western Canada. Following a brief introductory overview of the Grasslands Project by symposium organizer Terry Wheeler, six papers were presented:

- Joe Shorthouse (Laurentian University)  
– Attributes of Canada's diverse grasslands.
- Terry Wheeler and Stéphanie Boucher (McGill University) – Trophic guilds of higher Diptera in xeric Yukon grasslands.
- Rob Roughley (University of Manitoba)  
– The use of fire as a biodiversity and conservation management tool on tallgrass prairie.
- David Wade (University of Manitoba)  
– Spiders (Araneae) collected in a tallgrass prairie in southern Manitoba and their importance to prairie conservation.
- Michael Alperyn (University of Manitoba)  
– Ponds in prairie habitats: a changing dynamic illustrated by predacious water beetles.
- Dan Johnson (Agriculture and Agri-Food Canada, Lethbridge) – Temporal changes in the grasshopper (Orthoptera: Acrididae) fauna of Alberta grassland, in response to fire, weather and vegetation changes.

Abstracts of these papers can be viewed on the Biological Survey's website at: <http://www.biology.ualberta.ca/bsc/english/grasssymposium.htm>

The symposium also served as a launch for the Biological Survey's next major initiative in the Grasslands Project, a published volume on the ecology of grassland arthropods in Canada (see description below).

### Grasslands Volume in Preparation

The last major publication of the Biological Survey of Canada was *Insects of the Yukon*, summarizing in one place what is known about the composition and history of the fauna of the area, including annotated checklists of many groups. The grasslands project envisages a treatment of grassland arthropods with similar aims over the long term, but the diversity of arthropods in Canadian grasslands is such that a detailed study of most of the fauna is unrealistic in the short term, especially in a single volume. However, there are some defined species assemblages, habitats and/or ecological questions that have been, and are currently, the focus of comprehensive faunistic and ecological studies. Synthetic treatments of arthropod diversity in these habitats are feasible and an overview of such studies will constitute the first major published volume of the Grasslands Project, entitled *Arthropods of Canadian Grasslands: Ecology and Interactions in Grassland Habitats*. In addition to summarizing ecological research, the volume will include a series of chapters setting the stage for the Grasslands Project as a whole by giving an overview of the history of Canada's grasslands and the current diversity and distribution of grassland types across the country.

Letters of invitation have been sent to prospective authors for 19 chapters on the abiotic and biotic history of Canada's grasslands, arthropod species assemblages in selected grassland habitats across the country, changes in the grassland arthropod fauna, and the use of grassland arthropods in habitat assessment, conservation and planning.

Publication of the volume is anticipated in 2004.

For further information on the volume please contact Terry A. Wheeler (McGill University) ([wheeler@nrs.mcgill.ca](mailto:wheeler@nrs.mcgill.ca), 514-398-7937).



## Grassland Project Key Site 2003: Peace River Grasslands

<b>When:</b>	July 18 – 21, 2003 (or any part of that time)
<b>Where:</b>	Base camp will be <b>Dunvegan Provincial Park and Historic Site</b> (1hr drive north of Grande Prairie, Alberta). There is an interpretive centre, historic buildings, a riverside campground and even a market garden with strawberries ripe for the picking.
<b>How to get there:</b>	Grande Prairie is located about a 5-hour drive northwest of Edmonton. The city also has daily air service (West Jet and Air Canada). Ground transportation for those that fly will be arranged once we know who is coming.
<b>Accommodation:</b>	Camping is available for \$15/night at Dunvegan Provincial Park. The campground has all the amenities (electricity, water, playground). Motel accommodation is also available in the nearby town of Fairview (about 15 minutes away).
<b>Laboratory facilities:</b>	Sorting facilities will be primitive (picnic tables) but there is a covered picnic shelter in case of inclement weather.
<b>How to register:</b>	Contact Rob Roughley, Department of Entomology, University of Manitoba, Winnipeg, MB R3T 2N2; rob_roughley@umanitoba.ca; Tel.: 204-474-6023; Fax: 204-474-7628 <b>Before June 1, 2003</b>

This year's grassland excursion will take place in the remnant grasslands along the Peace River in northwestern Alberta. This unique grassland is home to at least nine disjunct butterfly populations, two disjunct tiger beetles and an untold wealth of other arthropods. The trip offers a tremendous opportunity to document the arthropod fauna of this dwindling prairie habitat because very little collecting has been done for taxa other than butterflies. Our motto this year: Expect the unexpected.

The grassland sites are located primarily along the south-facing breaks of the Peace River and include both steeper, eroded slopes (watch out for cactus) and broad benches. A day trip to Kleskun Hill Natural Area (an upland native prairie site east of Grande Prairie) may also be included. The grasslands are also great for birds and plants and the scenery is magnificent. For additional information about the area see the article "Remnant Peace River Grassland and Disjunct Butterflies" on p. 17.



For more information about Peace region specifics contact:

Margot Hervieux,  
Email: [hervieux@telusplanet.net](mailto:hervieux@telusplanet.net),  
Phone: 780-539-6102

Peace River slopes  
(photograph by M. Hervieux)



# Slant-faced grasshoppers of the Canadian Prairies and Northern Great Plains

Dan L. Johnson

Environmental Health, Agriculture and Agri-Food Canada Research Centre, PO Box 3000, Lethbridge, AB, T1J 4B1; and University of Lethbridge, 4401 University Drive West, Lethbridge, AB, T1K 3M4 Canada, dan.johnson@uleth.ca



Striped slant-faced grasshopper (female) at Drumheller, AB (see also p. 9)



A very green four-spotted grasshopper (male) from Medicine Hat, AB (see also p. 14)

When many people hear the word grasshopper, the image that comes to mind is often an insect in the group called the slant-faced grasshoppers. In Canada, slant-faced grasshoppers are all in the “stridulating slant-faced grasshopper” subfamily, also called the tooth-legged grasshoppers because the males possess a row of pegs on the inner side of the leg. The taxonomic name for this group is the subfamily Gomphocerinae, in the family Acrididae, of the Order Orthoptera. The tooth-legged grasshoppers can be distinguished easily from the other subfamilies of grasshoppers because they have no spur or spine-like process of the prosternum (‘throat’ area) like that of the subfamily Melanoplinae, and they do not have large, lobed and often coloured wings like the subfamily Oedipodinae (described in previous articles: Johnson 2001, 2002). The tooth-legged grasshoppers differ morphologically and behaviourally from the subfamily Acridinae, a small group of “silent slant-faced grasshoppers” that do not have stridulatory pegs on the legs, and do not occur on western Canadian grassland.

The tooth-legged grasshoppers are mostly slender and often streamlined, with the head point-

ed and often tipped forward. They sing by stroking their back legs across the edges of their wings. Most of them eat grass, and they can be quite specific in their preferred diets, sometimes eating mainly one species of native grass. Although the gomphocerine grasshoppers are often dominant in European ecosystems (compared to other kinds of grasshoppers), and in the US they may be abundant to the point of being economic pests, on Canadian grassland they usually account for less than 5% of the grasshoppers that could be found at random at a typical site. There are cases on the Prairies in which the tooth-legged grasshoppers comprise more than 20% of the grasshopper species present, and 100% of the adult grasshoppers present (even in summer, such as Johnson 1989), but normally they are found on Canadian grassland at densities of around one per square metre, to as low as one per 100 or more square metres. Some gomphocerine grasshoppers can increase to high densities when extended warm, dry weather increases their survival and reproduction rates. In 2002, tooth-legged grasshoppers reached densities of over 50 adults per square metre at some grassland sites near the Milk River



in Alberta, and comprised more than 95% of the grasshoppers present, so we should not assume that they are destined to remain minor components of northern grassland ecosystems, compared to the more numerous and visible spur-throated and band-winged grasshoppers.

The wings of tooth-legged grasshoppers are usually clear, short and slender, and may not even support flight. When these grasshoppers do fly, they do not normally make sound (called crepitation, common among the band-winged grasshoppers). Tooth-legged grasshoppers call by sawing a row of spines or pegs on the inner surface of the hind femur along the tegmen (the leathery forewing), making the rasping grasshopper sounds that are commonly heard on summer days. The club-horned grasshopper is often heard in early summer at short grass prairie, making a scratching sound that can be heard some distance away. Later in the summer, especially at sites with taller grass, the marsh meadow grasshopper male sings with a regular scratching sound with separated syllables, like *skit-skit-skit-skit*. Although some species of tooth-legged grasshoppers can make a little sound in flight, their calls are usually restricted to this stridulating from positions secreted in the grass. They sound distinctly softer and more repetitive than the buzz or rattle of the band-winged grasshoppers (subfamily Oedipodinae) in flight (crepitation), although they might be mistaken at first for certain meadow katydids, in the family Tettigoniidae. Spur-throated grasshoppers (subfamily Melanoplinae) also flick their legs and softly trill and buzz to indicate readiness to either mate or repel competitors, but using legs that are too smooth to produce sounds that the human ear can detect from more than a few metres distance.

All of the tooth-legged grasshopper species discussed below are, so far, relatively harmless to

agriculture in Canada in most years, and in fact many serve as important sources of food for birds and other wildlife. Recognition of species is mainly of interest to naturalists and ecologists who are interested in biodiversity, but knowledge of species is also of value to farmers and ranchers who do not want to make the mistake of taking control actions against non-damaging grasshoppers. It may also become important in the future to distinguish species, because some have the potential to become pests under certain warmer climate. They will not damage crops, but they have the potential to reduce forage and grazing productivity.

A few specialized terms will help in identifying the grasshoppers in this subfamily. Grasshoppers have four wings, and the pair of leathery, protective forewings are called the tegmina (one is a tegmen). The saddle-shaped back that lies just behind the head of a grasshopper is called the pronotum, so-called because it is the top part (notum) of the prothorax, the front of the thorax. The central longitudinal ridge of the pronotum is the median carina. Cuts or lines that run across the median carina from side to side are called sulci (singular: sulcus). The central dent or depression that may be found on the tip of the grasshopper head is the fastigium. To either side of the fastigium are the lateral foveolae, shallow depressions surrounded by small ridges, which can be seen in the field with a 10 H or 20 H hand lens (to find them, look closely at the tip of the head, between and just ahead of the eyes). These structures provide ways to separate some similar tooth-legged species, as described below.

For each species below, I have added some brief personal observations on ecology and changes in distribution.

***Acrolophitus hirtipes* (Say)**

Male resting, but not feeding,  
on a wheat plant

**Green fool grasshopper**

This large, hairy, light-green grasshopper has a strongly pointed head and a unique round crest rising like a half-moon on the pronotum. The median carina of the pronotum is cut by three sulci, and lateral foveolae are absent. A light-coloured diagonal stripe marks the side of the head, and the antennae are usually orange. The hind wings are relatively long and there is a dark band on the hindwing – unusual for Gomphocerinae. In flight it flutters as though it has wings and legs that are a bit too long, and it is easy to catch. If you take up grasshopper watching on the Canadian Prairies, you might see only a few of this flagship of the Gomphocerinae per summer (usually one at a time, often stridulating), but it is worth the wait. Good places to look are on rolling hills covered with short grass, or coulees where blue grama grass (*Bouteloua gracilis*) is dominant, in August.

***Aeropedellus clavatus* (Thomas)**

This common spring species has a strongly constricted hourglass marking on the pronotum, as do many tooth-legged grasshoppers (this is called constricted lateral carinae, because the outer ridges on the back seem to be squeezed in toward the midline). The club-like shape of the apical segments of the antennae, especially noticeable on the male, provides a good basis for identification of this species, even for the nymphal instars (the velvet-striped grasshopper discussed below has more broadly flattened apical segments, not as confined to the tip). This grasshopper is usually grey with black accents, but it can be green and silver-grey. The median carina is cut by one sulcus. The lateral foveolae are narrow rectangles.

The club-horned grasshopper is found throughout the grassland biome of the Prairie provinces, as well in forested ecosystems of the foothills and as far north as continental treeline. It is very common in May and June of some years, and frequently confuses pest managers watching for an early hatch of grasshopper pest species. The club-horned grasshopper overwinters in the egg stage, but hatches

**Club-horned grasshopper**

Male from near Edmonton, AB

more than a month earlier than the pest species. It can be heard in June and July making a *scritch-scritch-scritch* sound in the grass, and a captured or even dead specimen will make a rasping noise if you hold the back legs by the tarsi (feet) and move the legs up and down against the wings.



The club-horned grasshopper was found to be an important item in the diet of songbirds on Alberta semi-native grass pastures (Martin et al. 2000). The tegmina (wings) are very short in the flightless female, but usually run almost to the end of the abdomen in the male. Males fly, but not great distances, and changes in sex ratio of this species at a given site have been investigated as evidence of migration (Johnson et al. 1986).

Although some references note that high numbers have followed years of wet weather (Pfadt 1989), the highest populations of this species that I have seen in Alberta and southwestern Saskatchewan were during runs of several exceptionally warm, dry years such as 1985–88, and 2000–2003.



Female club-horned grasshopper resting in a wooded meadow near Lacombe, AB

#### *Ageneotettix deorum* (Scudder)



Male captured by a robber fly (Diptera: Asilidae), near the Lost River, AB

#### White whiskers grasshopper

This small, delicate grasshopper is named for its grey and thread-like antennae (visible in the photo of a white whiskers grasshopper captured by a robber fly, south of Onefour, AB). The hind legs seem a little oversized compared to the rest of the body. The hind tibiae are orange, with prominent black ‘knees’ where they join the femora (like some other tooth-legged species). This species is usually found on short grass, typically where blue grama grass is common.

The lateral foveolae are large and rounded but rectangular, unlike the otherwise somewhat similar big-headed grasshopper described below, which has triangular foveolae. If you have trouble recalling which is which, remember that ‘deor’ is like door, a rectangle. Brooks (1958) and Otte (1981) have comparative drawings (recommended for the artwork as well as for the taxonomy, ethology and biogeography).



***Amphitornus coloradus* (Thomas)**



Female sitting on epilithic lichens near the Lost River, AB

This species is easily recognized by its strongly slanted head, and brown, grey and dull gold longitudinal stripes on the body. The antennae are thread-like. The hind tibiae are usually blue, even in dried specimens. The lateral foveolae are shallow or not visible.

**Striped slant-faced grasshopper**

The striped slant-faced grasshopper is considered to be a significant rangeland pest in the US, and might cause economic damage to grazing potential in southern Canada if climate warms. Populations on the Prairies have increased slightly each year since 1998, but still remain below the economic threshold throughout the Canadian range.



Male at Estevan, SK

***Aulocara elliotti* (Thomas)**

This robust, blue-grey grasshopper has a noticeably large head. It can be quickly separated from the similar but slightly smaller white whiskers grasshopper by the blue tibiae and the triangular lateral foveolae (they are rectangular on *Ageneotettix deorum*). The median carina is cut by one sulcus. This species was very common in 2002. It is sometimes noticed because of its active stridulating, courtship behaviour and aggressive stances to other *A. elliotti* males and also to other species of grasshopper. The big-headed grasshopper is considered to be a serious range pest in the US, and it might significantly compete with livestock grazing in Canada if climate warms.

In dry years, watch for a rare related species, *A. femoratum* (the white cross grasshopper) in the dry mixed grass ecoregion. The white cross grass-

**Big-headed grasshopper**



Pair on sand near Spring Coulee, AB (the male is the smaller)

hopper can be recognized by the slightly shorter wing, lighter colour, dark bands on the hind femur and smaller body size.



### ***Bruneria brunnea* (Thomas)**

This grasshopper looks a little like a slightly bigger, slightly darker version of the white whiskers grasshopper. The hind femur has three dark angled bands (occasionally joined to make two). The pale hind tibia may be orange or tan, and the head often has a light horizontal stripe on each side of the face. Some have a longitudinal mid-dorsal yellowish stripe. The hindwings are long and appear shiny, with spots (but not large and joined spots like the four-spotted grasshopper below). The median carina is cut by one sulcus. The abdomen, especially of the male, may appear striped with dark rings. The lateral foveolae are rectangular, but are not more than three times as long as wide. This species lives on grassland as far north as the Peace River region, and is often found in meadows or partially wooded sites. In 1987-90, this species reached densities of several per square metre on sites near Brooks, AB, and in some unusual cases made up more than 25%

### **Bruner's grasshopper**



Grey form of the normally brown Bruner's grasshopper (female) near Loverna, SK

of the grasshopper community (e.g., Johnson 1989). It occurred at low densities on dry mixed grass in southern Alberta and Saskatchewan during 1991-97 (usually less than one per 100 square metres, and less than one per thousand grasshoppers).

### ***Chloealtis conspersa* (Harris)**

### ***Chloealtis abdominalis* (Thomas)**



Female sprinkled grasshopper in Highwood Meadows, near Kananaskis, AB. Most are brown and speckled, not coloured like this one.

These stocky grasshoppers are mainly found in grass-sedge meadows, wooded areas, foothills fescue, or where grassland meets parkland, including at the northern edge of the grassland biome. The wings of the male extend almost to the end of the abdomen, and are held roof-like over the body, reminiscent of caddisflies (Order Trichoptera) but

### **Sprinkled grasshopper**

### **Cow grasshopper**

with a flat, squared off dorsal surface. Lateral foveolae are absent. The pronotum is robust and angular, with a strong media carina cut by one sulcus. *C. conspersa* has tightly packed venation in the upper portion of the male forewing, and *C. abdominalis* has wider, more rounded patterns in the venation. The female wing of *C. abdominalis* is shorter and more bract-like than that of *C. conspersa*. Usually there is a dark band on the hind femur. *C. consper-*



Female cow grasshopper resting on gravel near Cochrane, AB



sa females are sometimes a finely speckled walnut brown, and females of both species can be variations of a pink or chalky rose. I once observed *C.*

*abdominalis* females attempting to oviposit in decayed wood and densely packed moss, unusual sites for a grasshopper to lay eggs.

***Chorthippus curtipennis* (Harris)**



Green and shiny male from Drumheller, AB

Like the lesser migratory grasshopper, a widespread member of the spur-throated subfamily, the marsh meadow grasshopper has a distribution that covers nearly all of North America. On the Canadian Prairies, it is found where grass grows relatively tall and dense. It is often associated with moist habitat (hence the common name), but populations can build up in years of adequate moisture and persist through several dry years. In 2002, it was one of the more common species in the extremely drought-stricken regions of Alberta and west-central Saskatchewan. This species is easy to recognize, with its slim yellow and green body, and slanted head. The lateral foveolae of this species are very narrow rectangles, clearly visible with a hand

**Marsh meadow grasshopper**

lens. The eyes appear large in comparison to the body, and may be quite dark in colour. The male has a long wing, but the larger female has wings only half as long as the abdomen (depending on breeding status, because the abdomen elongates prior to egg-laying, as with most grasshopper females). The abdomen of either sex may appear yellow and striped with dark rings, but do not confuse this with the yellow-and-black striped abdomen of Dawson's grasshopper (*Melanoplus dawsoni*), a spur-throated grasshopper which is also found in fescue grass and similar moister environments.



Female walking across a wild strawberry leaf near Stavely, AB

***Cordillacris occipitalis***

This small grasshopper is usually found only on dry, sandy rangeland that is often home to band-winged grasshoppers and xeric spur-throated grasshoppers. This species looks a bit like *A. coloradus*, but without the prominent stripes. It has been very rare on the Canadian Prairies for years, usually oc-

**Occipital grasshopper**

curing at less than one individual per 10,000 grasshoppers, but about as high as 1% of grasshoppers collected at one site in the Canadian Forces Base Suffield National Wildlife Area, Alberta (observed by D. Johnson and C. Andrews, unpublished report to the Canadian Wildlife Service 1994).



### ***Eritettix simplex tricarinatus* (Thomas)**



Female sitting on red shale near the Oldman River, AB

Although published summaries of specimen data and maps indicate that it is confined to the extreme dry zone of southeastern Alberta and southern Saskatchewan, I have found this species on native pastures, and even in roadsides, throughout southern Alberta including north of the South Saskatchewan River and Oldman River, and also in central Saskatchewan, during collecting in May.

### **Velvet-striped grasshopper (or western velvet-striped grasshopper)**

The warmer summers in recent years might explain their northern increases.

This is one of a half-dozen species that overwinter on the Canadian Prairies as nymphs, and complete development in the spring. This early-season grasshopper is sleek in appearance, usually grass-green and silver grey (but sometimes tan). *Psoloessa delicatula* and *Aeropedellus clavatus* can also be grey and green, and are also among the small number of species found as adults on northern grasslands in April and May, so the colour and date of collection can cause confusion. To find this species, look on well-grazed pastures or rangeland where blue grama grass is common.

The fastigium (flattened part of top of head) of this species is obvious and pointed. The lateral foveolae are shallow, and not visible from above. Two dark longitudinal stripes on the pronotum are quite noticeable, and highlighted by thinner, light-coloured stripes. The antennae are slightly flattened.

### ***Mermiria bivittata maculipennis* Bruner**

This grasshopper is not to be confused with the much more robust two-striped grasshopper (*Melanoplus bivittatus*) in the spur-throated subfamily, which has lighter stripes on a darker green background, and sometimes causes crop losses in the tens of millions of dollars. The two-striped slant-faced grasshopper has the reverse pattern, usually with two dark green stripes on each side of a lighter tan, green or grey central band running the length of the stream-lined body. The antennae are strongly flattened and wider at the base, and triangular in cross-section. Wings extend to the tip of the abdomen, but I have seen shorter-winged variants. The hind tibiae are usually tan but can be orange.

### **Two-striped slant-faced grasshopper**

As with some other tooth-legged and slant-faced grasshoppers, I have found the two-striped slant-faced grasshopper to be rare but present on pastures and grazing land throughout southern Alberta, and even at 51 degrees N latitude, although authoritative summaries of collection records and maps (Otte 1981, Pfadt 1989, Vickery and Kevan 1985) indicate that it is confined to the extreme south, very close to the US border. Although sampling effort may explain some of the discrepancy with previous collectors, the marked increase that I have noticed in recent years may be a result of warm, dry weather.



***Opeia obscura* (Thomas)**

The small, often straw-coloured, narrow body of this species and a tendency to sit still may be the reasons for the obscure species name. In Canada, it occurs infrequently in dry short grass ecosystems, where blue grama is dominant. The antennae are flattened at the base and triangular in cross-section. It has a slight bug-eyed appearance from above, because of the narrow head and slight body size. A ridge on the top of the head will confirm the identification. Both sexes have wings that almost reach the tip of the abdomen. Wings of this species are



Female collected at Val Marie, SK

**Obscure grasshopper**



Male collected near Wild Horse, AB

often short in Canada. Pfadt, 1989, indicates that in western states the wings are as long as or surpassing the end of the abdomen. Note that species list, colour, stripes and wing length noted in western US guides such as Pfadt (1989) may vary from what we observe on Canadian grasslands. During 1990–2002, I saw this grasshopper occasionally as far north as Oyen, AB and Lloydminster, SK, although previous records indicated that it was restricted to the region near the U.S. border.

***Orphulella speciosa* (Scudder)**

***Orphulella pelidna* (Burmeister)**



The rare spotted-winged grasshopper (male), basking on a rock near Onefour, AB

**Pasture grasshopper**

(on the prairies, mainly from Manitoba)

**Spotted-winged grasshopper**

(found in Alberta and Saskatchewan)

These slim grasshoppers look a little like a less colourful version of *A. coloradus*, with generally uncoloured but finely chevroned hind femora. Although they are small to medium-sized and slender, they have long wings, often with a row of small dark spots. The lateral foveolae are not clearly visible. The pronotum appears to have a dark longitudinal line with a pale ivory line above it. The lateral carinae are cut by two faint sulci. This is a rare species that I have found in isolated patches of dense grass and sedge.



### ***Phlibostroma quadrimaculatum* (Thomas)**

This species has been rare in Alberta and Saskatchewan for much of the last two decades, but it has increased in numbers in recent years. The four-spotted grasshopper has a rugged and even stout appearance from the side or from above, with the head and pronotum broad and appearing slightly oversized, but without a slanted face. They are usually green or grey, and occasionally tan. The lateral foveolae are not clearly visible. Wings of Canadian species usually do not reach to the end of the abdomen. The tegmina have large dark brown spots on the otherwise tan, green or grey background. These spots are often four in number and often triangular; when joined they look like dark jack-o'-lantern teeth hanging down from the top. *Cordillacris crenulata*, the spotted-winged grasshopper, a relative of *C. occipitalis* mentioned above, and some other slant-faced grasshoppers also have similar blotches on the wings, but these are longer, slimmer species that have a distinctly slanted face.

### **Four-spotted grasshopper**



Four-spotted grasshopper found near Shaughnessy, AB

### ***Pseudopomala brachyptera* (Scudder)**



Female blending with stone colours at the Writing-On-Stone campground, AB

This grasshopper is so elongated in the body and with such a pointed head that some observers think they have found a walking stick. It is sometimes called a toothpick grasshopper. The antennae are long, strongly flattened at the base, and triangular in cross-section. This is also a characteristic of the obscure grasshopper and the two-striped slant-

### **Bunch grass grasshopper**

faced grasshopper, but the bunch grass grasshopper is both slimmer and longer, and has shorter wings relative to the abdomen. The wings of the female bunch grass grasshopper may be only one-fourth to one-third of the length of the twig-like abdomen. It is usually grey to cream-coloured. This species has probably increased in abundance and range during recent dry years, and it has apparently adapted well to the widespread distribution of brome grass on prairie roadsides, where it is often found. Vickery and Kevan (1985) show only one collection record in Alberta and none in Saskatchewan. Vickery and Kevan (1983) note that on the Prairies it had been collected only "in one small coulee, at Onefour, Alberta", citing Brooks (1958). From 1983 to 1993, I found that this species was rare on the Prairies, but more recently I have found it to be infrequent but present across the southern Prairies, and I have collected it as far north as Provost and Coronation, Alberta, well north of 52 degrees N latitude. It would be interesting to know how it disperses.



***Psoloessa delicatula* (Scudder)**



Female on exposed soil at a pasture margin near Barnwell, AB

This species is usually the first tooth-legged grasshopper found in the spring, appearing even earlier than the velvet-striped grasshopper and the club-horned grasshopper (Savage 2002). The adults are gone in mid-July, and first and second instars appear (Table 1), and fourth and fifth instars overwinter.

This species has been shown to be an important food item for the survival of the nestlings of grassland songbirds. More than 80% of the food that grassland songbirds feed to their nestlings are grasshoppers, and in May and June this species is often the main item on the menu, easy to catch and neither too large nor too small to feed to nestling songbirds (Martin et al. 1998). Size and colour distinguish these early tooth-legged grasshoppers immediately from the darker and more robust band-winged grasshoppers that overwinter as nymphs and appear early in spring, mainly the speckled-winged grasshopper (*Arphia conspersa*) and the red-shanked grasshopper (*Xanthippus corallipes*). The brown-spotted range grasshopper is mainly grey with strong black contrasts, although it can be green and grey, or even tan and grey. The lateral foveolae are rectangular, and the pronotum from above appears as a strongly restricted hourglass, with the side ridges (lateral carinae) squeezed in at the middle, even more so than the

**Brown-spotted range grasshopper**

other tooth-legged species. Note that the brown-spotted grasshopper, the four-spotted grasshopper, and the club-horned grasshopper all have grey and black hourglass markings on the pronotum (bird's eye view). *P. delicatula* is without clubbed antennae, and has a smaller head and smaller spots on the tegmina than the four-spotted grasshopper (which usually does not appear as an adult until July). The inside of the hind femora of the brown-spotted grasshopper are clearly marked with black triangles, when seen from above, whereas the four-spotted grasshopper and the club-horned grasshopper have broken, dark bars but no triangles on the legs.

Table 1. Age structure of *Psoloessa delicatula*, on short grass at Onefour, Alberta (column percentages sum to 100 for a given sampling date).

Instar	Date (2000)						
	Jn 22	Jl 5-6	Jl 17-18	Jl 31-Aug 1	Aug 14	Sep 13	Oct 23
1	0	0	98	94	6.6	0	0
2	0	0	0.8	5.6	84	16	0
3	0	0	0	0	9.5	49	17
4	0	0	0	0	0	35	69
5	0	0	0	0	0	0.6	14
Adult	100	100	0.8	0	0	0	0

N=1,248 *P. delicatula*, 45% of the total acridid community; from 19,200 sweeps with a 38-cm net



Female (green form) on Sandburg's bluegrass near Onefour, AB



## References

- Brooks, A.R. 1958. Acridoidea of southern Alberta, Saskatchewan and Manitoba (Orthoptera). Canadian Entomologist Supplement 9: 3–92.
- Johnson, D.L., B.D. Hill, C.F. Hinks and G.B. Schaalje. 1986. Aerial application of the pyrethroid deltamethrin for grasshopper (Orthoptera: Acrididae) control. *Journal of Economic Entomology* 79: 181–188.
- Johnson, D.L. 2001. Band-winged grasshoppers of the Canadian Prairies and the Northern Great Plains. *Arthropods of Canadian Grasslands* 7: 5–12; H.V. Danks, ed. Biological Survey of Canada, Ottawa.
- Johnson, D.L. 2002. Spur-throated grasshoppers of the Canadian Prairies and the Northern Great Plains. *Arthropods of Canadian Grasslands* 8: 16–25; H.V. Danks, ed. Biological Survey of Canada, Ottawa.
- Johnson, D.L. 1989. The effects of timing and frequency of application of *Nosema locustae* (Microspora: Microsporida) on the infection rate and activity of grasshoppers (Orthoptera: Acrididae). *Journal of Invertebrate Pathology* 54: 353–362.
- Martin, P.A., D.L. Johnson, D.J. Forsyth and B.D. Hill. 1998. Indirect effects of the pyrethroid insecticide, deltamethrin on reproductive success of Chestnut-collared Longspurs. *Ecotoxicology* 7: 89–97.
- Martin, P.A., D.L. Johnson, D.J. Forsyth and B.D. Hill. 2000. Effects of two grasshopper control insecticides on the food resources and reproductive success of two species of grassland songbird. *Environmental Toxicology and Chemistry* 19: 2987–2996.
- Otte, D. 1981. The North American grasshoppers. Vol 1. Acrididae: Gomphocerinae and Acridinae. Harvard University Press, Cambridge, MA. 275 pp.
- Pfadt, R.E. 1989 (updated recently in electronic form). Field Guide to Common Western Grasshoppers. Wyoming Agricultural Experiment Station Bulletin 912.
- Savage, C. 2002. Peril of the prairie? *Canadian Geographic* May/June 2002: 42–50.
- Vickery, V.R. and D.K. McE. Kevan. 1983. A monograph of the orthopteroid insects of Canada and adjacent regions. Lyman Entomological Museum and Research Laboratory Memoir 13, Vol 2: 681–1467.
- Vickery, V.R. and D.K. McE. Kevan. 1985. The insects and arachnids of Canada. Part 14. The grasshoppers, crickets and related insects of Canada and adjacent regions. *Ultonota: Dermaptera, Cheleutoptera, Notoptera, Dictyoptera, Grylloptera and Orthoptera*. Agriculture Canada Publ. 1777. 918 pp.

## Acknowledgements.

All photographs were taken by the author, of grasshoppers collected by the author (except one of the club-horned grasshoppers, collected by Emile deMilliano), in Alberta (mainly), Saskatchewan and British Columbia. Erin Cadeiu and Sheila Torgunrud kindly scanned the slides. The sweeps in the table shown were conducted by the author and Craig Andrews. The assistance of Hugh Danks and Susan Goods in preparing this series is much appreciated.

[Production of this article with colour illustrations was supported by a contribution from Agriculture and Agri-Food Canada, Lethbridge and the University of Lethbridge.]



# Remnant Peace River Grassland and Disjunct Butterflies

Margot Hervieux

Peace Grassland Butterfly Project, 6410 – 99 A Street, Grande Prairie, AB, T8W 2K7  
hervieux@telusplanet.net

The vista spreads to the horizon. Wildflowers colour the waving grasses, a meadowlark sings from a saskatoon patch, prickly pear cactus cling to eroded slopes and *Oeneis alberta* flutter along the ridge top. Like all prairie landscapes, this place is full of surprises but perhaps the most intriguing is its location. Over 400 kilometres of boreal forest separate this grassland in north-western Alberta from the prairies of the south.

When Europeans first arrived in Alberta's Peace River country they found four large areas of prairie ranging in size from 1,500 to 9,300 sq. km. Not surprisingly, however, this open land was the first to be cultivated and in less than 100 years most of this fragile landscape disappeared. Current

inventory work by the Alberta Conservation Association (*pers. comm.* and 2002) indicates that these grasslands are now restricted to the south-facing slopes of the Peace River and adjoining tributaries as well as to some upland fragments (primarily in the Kleskun Hills east of Grande Prairie) which currently represent less than 0.5% of the original native grassland land base.

The prairies of the Peace Country are part of the Peace Parkland ecoregion. Open areas of *Stipa-Carex-Agropyron* grassland are interspersed with patches of saskatoon (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*) and wild rose (*Rosa woodsii*). Aspen (*Populus tremuloides*) and willow (*Salix* spp.) line creeks and other damp areas. These grasslands are home to a unique assemblage of plants, birds and invertebrates many of which are more often associated with the southern prairie. Disjunct populations of at least eight grassland butterflies and two tiger beetles have already been identified for this area and a very preliminary moth survey turned up a number of unexpected species. Detailed surveys of other major arthropod taxa are lacking.

In an attempt to assess the status of the disjunct Peace grassland butterflies, Alberta Fish and Wildlife conducted a survey of historic butterfly sites during the summer of 2001 (Hervieux 2002). Eight species were tracked: plain's skipper (*Hesperia assiniboia*), Pike's old world swallowtail (*Papilio machaon pikei*), coral hairstreak (*Satyrium titus*), striped hairstreak (*Satyrium liparops*), northern checkerspot (*Chlosyne palla*), Gorgone checkerspot (*Chlosyne gorgone carlota*), Alberta arctic



Plain's Skipper  
(photograph by  
M. Hervieux)



(*Oeneis alberta*) and Uhler's arctic (*Oeneis uhleri varuna*). Ten of 28 known sites were visited (based in part on Kondla et al. 1994) and 16 new locations were identified. It became clear during the 2001 survey that long-term monitoring of these butterflies was needed as well as an assessment of habitat use.

The Peace Grassland Butterfly Survey was established by the author in the spring of 2002 with grant support from the Alberta Conservation Association. Transects were established at four sites (two river slope and two upland) and monitored on a weekly basis from May through August. Methods were based on Pollard (1977) and the Ohio Lepidopterists Long-term Monitoring Program (2000). Flowering plants were also recorded along two of the transects on a bi-weekly basis and a detailed plant inventory was conducted for each transect. This plant survey information provides valuable data for assessing butterfly habitat use over time and can be used as a baseline for other arthropod surveys in the future.

Another important component of the Peace Grassland Butterfly Survey is population differentiation. This part of the project was initiated by Dr. Felix Sperling at the University of Alberta. Using specimens collected along the survey transects and at other grassland sites, his research team will assess the genetic relationship between the disjunct Peace region populations and populations in the south. In addition to assessing sub-species status, the genetics of these butterflies may reveal clues about the origins of this remnant prairie. There is

conflicting evidence as to how the grasslands became re-established after the last ice age and relationships between Peace country, mountain and prairie butterfly populations may offer new insights.

Butterfly numbers fluctuate greatly from year to year and only through long-term monitoring can we hope to assess population status and habitat use for these disjunct grassland butterflies. This project will increase our understanding of these unique butterflies and thereby enhance the conservation and management of native grassland in the Peace region.

## References

- Acorn, J. 2001. Tiger Beetles of Alberta. University of Alberta Press. Edmonton, Alberta.
- Alberta Conservation Association. 2002. URL: [www.ab-conservation.com](http://www.ab-conservation.com)
- Hervieux, M. 2002. Survey of native grassland butterflies in the Peace parkland region of northwestern Alberta – 2001. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 47. Edmonton, Alberta.
- Kondla, N.G., E.M. Pike and F.A.H. Sperling. 1994. Butterflies of the Peace River Region of Alberta and British Columbia. *Blue Jay* 52(2):71–90.
- Ohio Lepidopterists Long-term Monitoring Program. 2000. URL: <http://www.dnr.state.oh.us/wildlife/resources/lepid/default.htm>
- Pollard, E. 1977. A method for assessing changes in the abundance of butterflies. *Biological Conservation* 12:115–134.



Highland Park in the autumn  
(photograph by M. Hervieux)



# The effect of burn season on the spider fauna of tallgrass prairie

David Wade

Department of Entomology, University of Manitoba, Winnipeg, MB R3T 2N2  
dwade@mb.sympatico.ca

## Abstract

The effect of burn season (spring, summer, and fall) on the spider fauna of tallgrass prairie was investigated over a four year period. Spider abundance declined significantly following each burn season but recovered after three years. No significant difference in species richness or dominance diversity was observed between the treatments in any year. Species diversity showed some significant trends with the summer and fall burn treatments tending to have the highest diversity values. My recommendations for tallgrass prairie management are to incorporate all three burn seasons and to allow approximately four years between burns.

## Introduction

Tallgrass prairie is an endangered habitat with less than 1% remaining in North America (Morgan 1994, Robertson et al. 1997). Burn management strategies have focused on spring burns as the primary burn season (Collins and Steinauer 1998, Schwartz and Hermann 1997). As such, the effect of non-spring burns on the biodiversity of tallgrass prairie is poorly studied. This is especially true for spiders in which all known studies have been done using spring burns (e.g. Harper et al. 2000, Nagel, 1973, Riechert and Reeder 1972, Rice 1932). To address this lack of information, a multidisciplinary project was initiated in 1997 to investigate the effect of burn season (spring, summer, and fall) on three tallgrass prairie faunas: plants, ground beetles (Carabidae), and spiders (Araneae). I was responsible for the effects on the spider fauna and the following article is a summary of my research.

## Methods

The experiment was conducted on a portion of the St. Charles Rifle Range (SCR), which is located just northwest of Winnipeg, Manitoba. The SCR is 192 hectares in size and contains 47.9 hectares of high quality tallgrass prairie (Morgan 1994).

The treatment areas consisted of 50 meter by 50 meter plots arranged in a cross pattern (Fig. 1). The treatments were replicated four times and each plot contained sixteen pitfall traps arranged in a four by four grid (Fig. 1). These pitfalls were emptied weekly during the snow free periods of the years 1997–2000. There were 6 treatments: refuge, control, botanical standard, spring burn, summer burn, and fall burn. The burns were conducted once in 1997, occurring on June 6 for the spring burn, August 5 for the summer burn, and September 9 for the fall burn. The remaining three treatments were never burned and the botanical standard was never sampled for arthropods.

The sixteen pitfall traps per plot were pooled weekly and sorted to extract the target arthropods. I identified all of the spiders, following the nomenclature of Platnick (2002).

## Results

There were 54,396 adult spiders collected during the study, representing 126 species. The abundance of spiders in each treatment decreased significantly following their respective burns but recovered to pre-burn levels in 2000. Species richness increased over the study period but no significant differences were observed between treatments in any year. The dominance diversity indices (Simpson and Berger-Parker indices) did not detect any significant differences between the treatments in any year but all three burn treatments tended to have lower dominance than the refuge treatment. The summer and fall burn treatments had the highest species diversity, based on the Shannon-Wiener and log series alpha indices, but these values were only significantly higher in 1997 and 1998.

*Pardosa moesta* Banks and *P. distincta* (Blackwall) were the most abundant species, accounting for 31.4% and 21.7% of the spiders caught

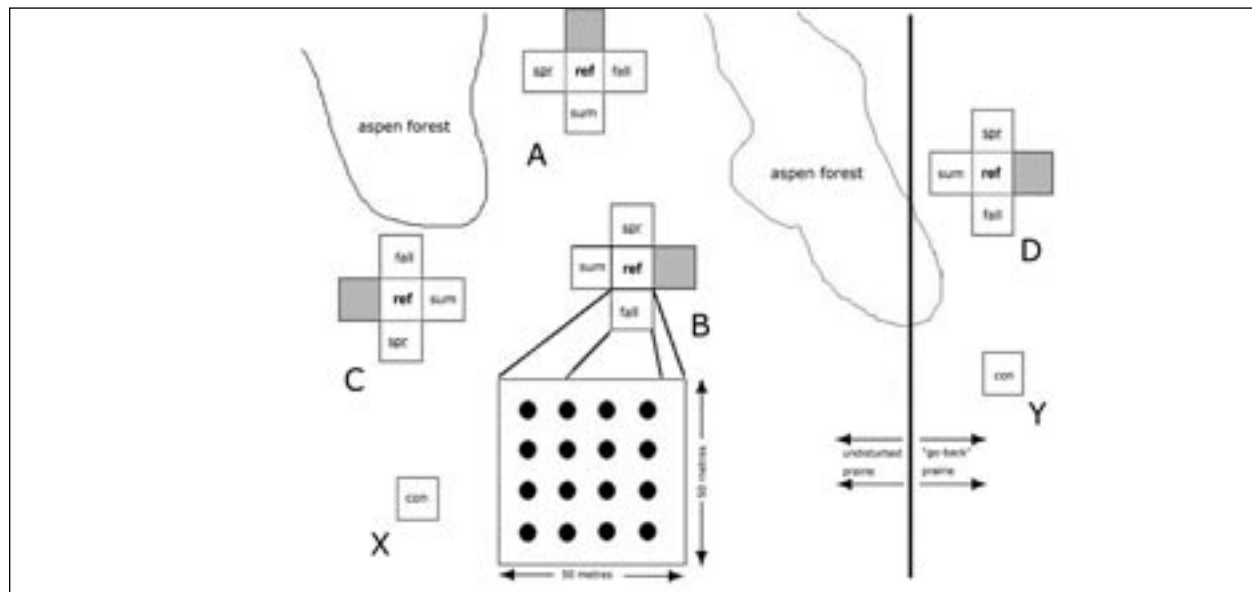


Fig. 1. Schematic diagram of experimental design for the St. Charles Rifle Range tallgrass prairie project. spr = spring treatment, sum = summer treatment, fall = fall treatment, ref = refuge treatment, con = control treatment. Grey square represents the botanical standard (modified from Roughley 2001).

respectively. Prior to burning, *P. moesta* was the dominant species in all blocks except block D, where *P. distincta* was dominant. Following the summer and fall burns, *P. distincta* became the dominant species in those treatment plots for all blocks but *P. moesta* remained dominant in the spring and refuge treatments (except in block D).

## Discussion

Previous studies (Nagel 1973, Riechert and Reeder 1972, Rice 1932) on the effect of spring burns on spiders showed no effect on diversity, only a decline in abundance that eventually recovered, which was also seen with this study. However, the effect of the summer and fall burns yielded different results. These two burns resulted in a switch in the dominant spider species from *Pardosa moesta* to *P. distincta*. Coupled with this switch in the dominant species was an overall decline in the dominance values and an increase in species diversity. This *P. distincta*-dominated community was also more stable in that it exhibited resistance and resilience to the effect of burning, regardless of the burn season. At the species level, some species increased in abundance following the summer and fall burns.

These species included *P. distincta*, *Hogna frondicola* (Emerton), and *Arctosa rubicunda* (Keyserling).

My recommendations based on the results of this study are to use all three burn seasons in management practices. All three showed unique results and by using all three burn seasons, the overall diversity of the prairie will be greater. The burn cycle should be around four to five years to allow the spider populations to fully recover from the negative impacts of fire. Some areas need to remain unburned as the spiders in this study as well as other studies (e.g. Harper et al. 2000) show that they rely heavily on recruitment during the post-fire period. These recommendations agree with those of Roughley (2001) and Sveinson (2001), which were based on the ground beetles and plants respectively.

## Acknowledgements

I wish to thank the Department of National Defence, NSERC, and the University of Manitoba for funding. I want to thank my advisor, Dr. R.E. Roughley, for getting me interested in spiders. I also want to thank all the staff and volunteers who helped over the years. I especially want to thank Jackie LeGal for helping me sort through all the spiders.



## References

- Collins, S.L. and E.M. Steinauer. 1998. Disturbance, diversity, and species interactions in tallgrass prairie. pp. 140–156 in Knapp, A.K., J.M. Briggs, D.C. Hartnett, and S.L. Collins, eds. Grassland dynamics: Long-term ecological research in tallgrass prairie. Oxford University Press, New York. 364 pp.
- Harper, M.G., C.H. Dietrich, R.L. Larimore, and P.A. Tessene. 2000. Effects of prescribed fire on prairie arthropods: an enclosure study. *Natural Areas Journal* 20: 325–335.
- Johnson, S.R. 1995. Spider communities in the canopies of annually burned and long-term unburned *Spartina pectinata* wetlands. *Environmental Entomology* 24: 832–834.
- Morgan, J. 1994. Prototype vegetation management plan – prairie habitats. Canadian Forces Base–Winnipeg. iv + 38 pp.
- Nagel, H.G. 1973. Effect of spring prairie burning on herbivorous and non-herbivorous arthropod populations. *Journal of the Kansas Entomological Society* 46: 485–496.
- Platnick, N. I. 2002. The world spider catalog, version 3.0. American Museum of Natural History, online at <http://research.amnh.org/entomology/spiders/catalog81-87/index.html>
- Riechert, S.E. and W.G. Reeder. 1972. Effects of fire on spider distribution in southwestern Wisconsin prairies. pp. 73–90 in J.H. Zimmerman, ed. Proceedings of the 2nd Midwest Prairie Conference, University of Wisconsin, Madison. 242 pp.
- Rice, L.A. 1932. The effect of fire on the prairie animal communities. *Ecology* 13: 392–401.
- Robertson, K.R., R.C. Anderson, and M.W. Schwartz. 1997. The tallgrass prairie mosaic. pp. 55–87 in Schwartz, M.W., ed. Conservation in highly fragmented landscapes. Chapman & Hall, New York, NY. xvi + 436 pp.
- Roughley, R.E. 2001. St. Charles Rifle Range tallgrass prairie: an endangered habitat. The use of fire as a biodiversity and conservation tool. University of Manitoba. 81 pp.
- Schwartz, M.W. and S.M. Hermann. 1997. Midwestern fire management: Prescribing a natural process in an unnatural landscape. pp. 213–233 in Schwartz, M.W., ed. Conservation in highly fragmented landscapes. Chapman & Hall, New York, NY. 436 pp.
- Sveinson, J. 2001. Botany. pp. 38–49 in Roughley, R.E. St. Charles Rifle Range tallgrass prairie: an endangered habitat. The use of fire as a biodiversity and conservation tool. University of Manitoba. 81 pp.



Tallgrass prairie at the St. Charles Rifle Range  
(photo from Department of Entomology, University of Manitoba)



# Factors affecting the community ecology of predacious diving beetles (Dytiscidae) in lentic habitats across southern Manitoba

Michael Alperyn

Department of Entomology, University of Manitoba, Winnipeg, MB R3T 2N2  
malperyn@hotmail.com

## Introduction

Dytiscids are a group of predacious water beetles, which are locally abundant, and structurally diverse (7<sup>th</sup>/118 families in terms of species in Canada) (Larson et al. 2000). In lentic habitats, particularly in temporary and permanent ponds, dytiscids are diverse and abundant. This high diversity within Dytiscidae has been a point of growing interest for ecologists; however, despite this interest, the community ecology of this group has been understudied (Larson et al. 2000).

The purpose of this study was to examine predacious water beetle (Coleoptera: Dytiscidae) communities along a latitudinal transect across southern Manitoba with two objectives: (1) comparison of dytiscid communities in boreal and prairie ecozones, and (2) examination of the environmental factors within lentic habitats that affect dytiscid communities.

## Methods

The research was carried out during 2001 and 2002. Eight localities were selected across southern Manitoba (Fig. 1). Five localities are located in the prairie region, one in the boreal plains, and the remaining two in the boreal region of the province. Within each of these localities, 3–5 ponds were chosen for a total of 32 ponds.

Ponds were defined by Roughley and Larson (1991) as a “small permanent body of water; small enough surface area that wave action does not significantly affect shoreline so that fringing organic matter and emergent plants occur; generally with an open-water central area”. By this definition, aquatic habitats that are typically known as ‘small lakes’

were included for comparison with smaller water bodies (traditionally known as ponds).

Predacious diving beetles were sampled using bottle traps and volume samples. Bottle traps were constructed out of two-litre plastic soft drink bottles. The bottle traps were set for 24 hrs. period and dytiscid catches were preserved in 70% ethanol. Volumetric samples were used to sample adult dytiscids and also odonate (Odonata) larvae.

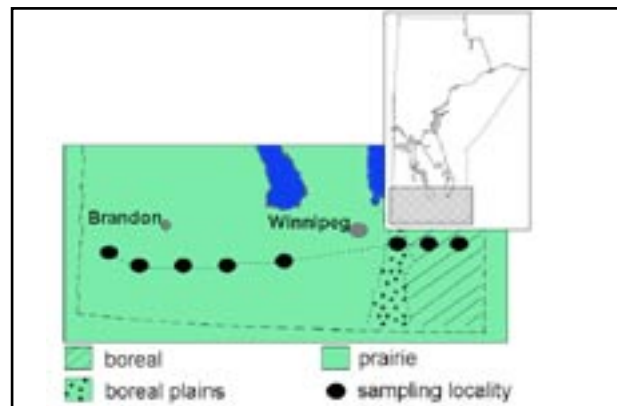


Figure 1. Map of sampling region in southern Manitoba. The locations of the 8 sampling localities are indicated, as well as a generalized outline of the ecozones for this region.

Volumetric samples were taken with a volume sampler constructed from an aluminium garbage can with the bottom cut out of it. This created an isolated volume, when the bottom of the apparatus was placed firmly into the substrate of the pond. With the volume sampler in place the contents were netted and placed into a sorting tray; this was repeated until no dytiscids were collected from the volume sample. Dytiscids were then sorted manually in the field and preserved in 70% ethanol.



In conjunction with volume sampling, aquatic macrophytes were sampled once in August 2001. With the volumetric sampler randomly placed, and prior to the contents being netted for aquatic organisms, the five most abundant aquatic macrophytes within the defined volume were identified and assigned a value of per cent coverage.

Hydrological parameters, pH, turbidity, and conductivity were measured for each monthly sampling visit. Water samples were taken and subsequently filtered for algae from which chlorophyll density was calculated. Chlorophyll density was used as an indicator of primary productivity.

### Preliminary findings

The identification of all the material is not yet complete and thus only a generalized account is provided from the 2001 data. To date, over 60 species of predacious water beetles have been collected and identified, including a new record for the province, *Hydrovatus pustulatus* (Melsheimer), found near Falcon Lake, Manitoba.

Prairie ponds yielded a greater abundance of dytiscids than ponds located in the boreal region of the province. However, boreal ponds matched or exceeded prairie ponds in species richness. Abundance of dytiscids in prairie ponds may be linked to substantial primary productivity occurring in these ponds. In addition, prairie ponds host



Figure 2. Sampling with the use of a volume sampler and aquatic dip net.

a greater diversity of aquatic macrophytes than comparable boreal ponds. These plants may favour dytiscids both directly and indirectly. Directly, a diverse assemblage of macrophytes provides oviposition sites for many species of dytiscid (Larson et al. 2000) as well as protection from predation. Macrophytes may also be favourable indirectly because they host an abundant population of macroinvertebrates (Gerking 1962, Gilinsky 1984, Parson and Matthews 1995), providing a food source for dytiscids.

### Acknowledgements

Funding for this research was provided by NSERC to Dr. R.E. Roughley. Thanks go out to my committee members for all their recommendations throughout the course of this project. I am also indebted to my field assistants and landowners that allowed me to work on their property.

### References

- Larson, D. J., Y. Alarie and R. E. Roughley. 2000. Predaceous diving beetles (Coleoptera: Dytiscidae) of the Nearctic Region, with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa, Ontario, Canada.
- Roughley, R.E. and D.J. Larson. 1991. Aquatic Coleoptera of springs in Canada. *Memoirs of the Entomological Society of Canada* 155: 125–140.
- Gerking, S. D. 1962. Production and food utilization in a population of bluegill sunfish. *Ecological Monographs* 32: 31–78.
- Gilinsky, E. 1984. The role of fish predation and spatial heterogeneity in determining benthic community structure. *Ecology* 65: 455–468
- Parson, J.K. and R. A. Matthews. 1995. Analysis of the associations between macroinvertebrates and macrophytes in a freshwater pond. *Northwest Science* 69: 265–275.



## Arthropod assemblages in cattle dung

K.D. Floate

Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB T1J 4B1

floatek@agr.gc.ca

Grassland represents about 5 percent of Canada's land base. Today, it exists as either native range or improved pasture. Native range is uncultivated grassland that provides the necessities of life for grazing animals, both native and domesticated, with a native plant community predominately comprised of grasses, forbs and shrubs maintained in this state by grazing pressure. Improved pasture, also termed cultivated or arable grassland, describes grassland subjected to cultivation, planting techniques and subsequent chemical inputs used to establish and maintain introduced forage species. Collectively, native range and improved pasture provide the land base to support Canada's national herd of 13 million beef cattle.

Cattle dung is an important but often overlooked byproduct of cattle on pasture. Assuming no overlap of dung pats, the average area covered by dung is about 0.8 square meters per animal per day. For a grazing season of 150 days, a herd of 100 animals would cover about 1.2 hectares (3 acres) of pasture in dung. Available forage is further reduced, because cattle avoid grazing near pats. Also, dung left on the soil surface to dry may lose up to 80 percent of its nitrogen into the atmosphere as ammonia. Hence, undegraded dung pats represent a loss of grazing area and a loss of soil nitrogen from the pasture.

Fortunately, many arthropods live in cattle dung and accelerate the rate at which the dung pat is broken down and returned to the soil. At least 450 species occur in cattle dung in North America and more than 80 of these occur in western Canada. The typical arthropod community in cattle dung on pastures of south-

ern Alberta includes dung beetles (Scarabaeidae), flies (e.g., Anthomyiidae, Calliphoridae, Muscidae, Scatophagidae, Scatopsidae, Sepsidae, Sphaeroceridae), parasitic wasps (e.g., Braconidae, Diapriidae, Eucoilidae, Figitidae, Ichneumonidae, Pteromalidae) and miscellaneous species of beetles (Hydrophilidae, Lathridiidae, Ptiliidae, Staphylinidae) and mites (e.g., Eviphididae, Halolaelapidae, Macrochelidae, Parasitidae, Uropodidae). Pest species, such as horn fly, stable fly and face fly also breed in pats, but represent only a small fraction of the total species richness.

Dung beetles are among the most conspicuous members of the dung community by virtue of their size and their abundance during certain times of the year. During a three-year study near Lethbridge, Alberta (Floate and Gill 1998), 156,000 of these beetles representing 17 species were recovered using pitfall traps baited with cattle dung. More than 92 percent of individuals were European species. Local assemblages were dominated, in descending order, by the exotic species *Onthophagus nuchicornis* (Linné), *Aphodius prodromus* (Brahm), *A. distinctus* (O.F. Müller), and *A. fimetarius* (Linné).



(photograph by K.D. Floate)



*Aphodius vittatus* Say was the most common native species.

Although adults occur from mid-March to mid-November, the adult activity of individual species exhibit one of two general patterns. The activity of *A. prodromus*, *O. nuchicornis*, *A. fimetarius*, and *A. distinctus* is bimodal, peaking in the spring and in the fall. In contrast, *A. vittatus*, *A. ruricola* Melsheimer, *A. coloradensis* Horn, *A. granarius* (Linné), *A. fossor* (Linné), and *A. haemorrhoidalis* (Linné) exhibit one peak of activity in spring to mid-summer.

These patterns likely correspond to differences in overwintering strategy. Species in the first group probably all overwinter as adults. They emerge in spring to colonize and lay eggs in fresh cattle dung or in the soil below fresh cattle dung. The fall period of activity reflects the emergence of the new generation of adults. *Aphodius distinctus* is an exception. It also exhibits a bimodal peak of activity and overwinters as an adult, but apparently only comes to cattle dung to feed. Oviposition occurs in horse manure or in vegetation decaying in the soil. Species in the second group overwinter as immature stages. They complete their development in the spring, then emerge as adults in late spring and summer to colonize fresh cattle dung and lay eggs.

“Have exotic species driven native species of dung beetles to extinction?” This question arises from the absence of any evidence of native species specific for bison dung. The answer is “Probably not”. Bison and cattle co-occurred in North America during European settlement and produce dung of similar type. Hence, if there was a native dung beetle fauna, it should have persisted in cattle dung through to the present day. In all likelihood, European species fill a previously vacant niche and accelerate dung degradation above that observed during pre-European settlement.

Although dung beetles are not pest species, they do generate some interesting phone calls. Reports of white grubs in crop land were received by the author from several locations in Alberta in 2000, with densities recorded of up to 90 larvae per m<sup>2</sup>. Specimens reared to adults identified the species as *A. distinctus*, *A. granarius* and *A. prodromus*,

which probably oviposited in response to the incorporation of crop residue and composted cattle manure into the affected fields.

In 2002, several golf courses in southern Alberta reported shiny black beetles on putting greens. The concern wasn't that the beetles were destroying turf, but rather that they acted as little 'bumps' that interfered with the roll of balls – much to the frustration of golfers. Collections of several hundred specimens were identified by the author as *A. pinguellus*, likely attracted to the greens by the use of organic fish fertilizers.

Further details of dung beetles common to cattle dung in Canada are provided in Floate and Gill (1998).

## Reference

- Floate, K.D. and B.D. Gill. 1998. Seasonal activity of dung beetles (Coleoptera: Scarabaeidae) associated with cattle dung in southern Alberta and their geographic distribution in Canada. *Canadian Entomologist* 130: 131–151.



*Aphodius distinctus*



## Web Watch: The Nature Conservancy of Canada and the Missouri Coteau

K.D. Floate

Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB T1J 4B1  
floatek@agr.gc.ca

The Nature Conservancy of Canada (NCC) is a national charity dedicated to the conservation of ecologically significant land through private action, and to its long-term stewardship through monitoring and management agreements. Preservation of grassland habitats is an ongoing priority of the NCC and several grassland regions are specifically targeted for conservation. One such region is the Missouri Coteau.

The Missouri Coteau is an extensive glacial moraine covering approximately 66,500 km<sup>2</sup> (26,000 square miles) in Canada and the United States, of which about 25,000 km<sup>2</sup> (10,000 square miles) occurs in Saskatchewan. It extends northwest from the international boundary south of Regina across the South Saskatchewan River and ends west of Saskatoon. The area is characterized by some of the largest remaining tracts of native prairie and contains a high density of potholes and lakes. This is the most important prairie duck breeding area, especially for the Northern Pintail. The area is home to several species at risk: Piping Plover, Burrowing Owl, Sprague's Pipit, Ferruginous Hawk, Loggerhead Shrike, Long-billed Curlew, Yellow Rail, Great Plains Toad, and Northern Leopard Frog. The Monarch Butterfly, classified as a 'Species of Special Concern', also occurs in the region.

Because of the high species diversity and relatively large amounts of native habitat still present, the Missouri Coteau area has been targeted by several conservation agencies with the NCC playing a major role in land securement. The farming and ranching community is experiencing social and economic challenge, with changes in land ownership and new economic initiatives resulting in more intensive land use. It is hoped that rural economic development will benefit from conservation planning and programs as well as nature-based tourism.

Although NCC has not completed a project in this area, they are working with partner organizations to share databases, referrals and are taking a pro-active approach to land conservation. The Missouri Coteau will become one of NCC's key focus areas and has been targeted by Environment Canada as a First Step Project for Habitat Stewardship through the new Species at Risk Act.

Preservation of land parcels within the Missouri Coteau may provide opportunities for partnerships to assess arthropod biodiversity. Arthropods currently reported for the region are listed by Saskatchewan Conservation Data Centre on the Internet at: <http://www.biodiversity.sk.ca/FTP.htm>.

Details of NCC and their other projects can be located on the Internet at:  
<http://www.natureconservancy.ca>

A map showing the extension of the Missouri Coteau into Canada is provided by Environment Canada on the Internet: <http://www.mb.ec.gc.ca/info/news/cc00s61.en.html>

### Acknowledgments:

Much of the above text is from the NCC's website, with minor modification.



(photograph by K.D. Floate)



# Human Impact on the Habitats of Prairie Insects

J. D. Shorthouse

Department of Biology, Laurentian University, Sudbury, Ontario, P3E 2C6  
jshortho@nickel.laurentian.ca



Grasslands near Jenner, Alberta  
(natural grasslands)



Canola near Red Deer, Alberta  
(altered grasslands)

## Introduction

The preparation of three volumes on arthropods of Canada's grasslands is the most ambitious project to date of the Biological Survey of Canada. This project, under the working title of 'Arthropods of Canadian Grasslands' not only will cover a large expanse of Canada and a wide variety of complex habitats, but will involve researchers and authors from across Canada and elsewhere. Some project participants will not have an opportunity to travel extensively on the prairies, but it is important that all have a good grasp of the range and types of ecosystems inhabited by insects today.

One of my roles in the BSC Grasslands Project is to provide an overview of the attributes of Canada's grassland ecosystems and discuss the diversity of habitats for insects. Like other participants in the project, I was aware that much of the prairies have been altered by human activities, but was not aware of the extent and speed by which this alteration occurred.

Many authors have written about the history of anthropogenic change to the ecosystems of southern Alberta and Saskatchewan (e.g. Turnbull 1979; Finnamore 1992; Potyondi 1995; Radenbaugh and Douaud 2000) and one of the objectives of the BSC

project will be to document how these changes influence the distribution and abundance of insects. Even though I have traveled extensively throughout the prairies, I had not looked at them in a way that highlights the degree of this change. Therefore, I took an 11-day exploratory trip in July, 2002, accompanied by my wife, to compare and contrast what natural ecosystems we could find with those altered by human activities.

Our intent during the trip was also to visit and photograph a wide range of insect habitats and to search for grasslands that were unbroken and as pristine as possible near major highways that could serve for biodiversity studies. Another of my projects is an overview of insect communities associated with prairie wild roses and July was an ideal time to find roses in flower, so that insect pollinators could be collected simultaneously.

Sadly, few prairie ecosystems are completely free of human influence. It is estimated that about 80% of the mixed and moist mixed grasslands, 90% of the fescue grasslands and about 80% of the aspen parkland to the north has been permanently altered (Acton et al. 1998). Further, it has been suggested



that the changes in most areas are permanent and irreversible (Potyondi 1995).

### History of anthropogenic change

The key message provided by Potyondi in his 1995 book is not only the extent of anthropogenic change, but also the speed at which it has occurred. In three quarters of a century – one lifetime – the complex bison landscape that had dominated the prairies for 12,000 years or more yielded to a simplified ecosystem devoted to monoculture production. Over much of southern Alberta and Saskatchewan, there was a loss of indigenous species between 1860 and 1930 and their replacement with a small number of exotic domesticated species valued chiefly for the commercial profits they generate.

According to Potyondi (1995), there have been at least 10 major stages or events leading to the state of prairie ecosystems we see today:

1. Culture based on bison ~5000 years ago to 1850's
2. Economy based on bison 1850-1885 (robes, tongues and bones)
3. Elimination of bison by about 1879
4. Introduction of cattle from USA in 1880
5. Construction of the Canadian Pacific Railway in 1881
6. Arrival of farmers in 1908
7. Elimination of grass fires
8. Intentional introduction of exotic species
9. Unintentional introduction of exotic species
10. Use of fertilizers, herbicides and insecticides

The plains bison (*Bison bison bison*), the largest terrestrial mammal in North America, was the dominant herbivore on the grasslands of North America for about 10,000 years. These animals numbered in the millions on the Canadian prairies and played a key role in sustaining grassland ecosystems (Foster et al. 1994; Knapp et al. 1999). Migration paths became highways of hard-packed earth. Bison trampled vegetation and uprooted trees, an important factor in checking the invasion

of aspen poplar. They turned the moist ground adjacent to bodies of water into a hummocky landscape and churned up and fouled the water itself. They must have been an important host for biting flies.

Bison left huge amounts of faeces on the plains which, besides providing valuable nutrients for grasses, must have been a key food source for numerous species of coprophagous insects. Bison were a key resource for indigenous peoples on the Canadian plains for about 5000 years; however, around 1850 natives and Métis began harvesting them for robes, tongues and hides for eastern markets. Harvesting was so intense that by 1879, all plains bison in Canada were exterminated. Only about 1000 were left in the USA and all bison reintroduced into Canadian parks and ranches came from these animals.

Within 10 years of the demise of bison, American ranchers brought thousands of cattle to southern Alberta and Saskatchewan to graze the range, unmolested, until the annual fall round-up. These ranchers also decimated natural predators such as wolves, coyotes and bears and eliminated many coyotes and foxes. Starving natives decimated the remaining large herbivores such as deer, antelope and elk.

Free-roaming cattle were present for about 10 years. In 1882-1883, the Canadian Pacific Railroad crossed through the area from Winnipeg to Calgary and farmers began arriving by train. Much of the arable land near the railroad became privately owned and when these lands were fenced with barbed wire, farmers rapidly displaced the ranchers and their free-roaming cattle.

Fencing increased grazing pressure which affected the composition of the range. Livestock commonly cropped the grass beyond its capacity to recover quickly, resulting in loss of soil moisture, reduced plant vigour and changes in floristic composition. Some species such as the more drought-resistant blue grama grass (*Bouteloua gracilis*) became more abundant. Fencing lands and the construction of roads also eliminated the natural occurrence of fire.

Prior to the arrival of farmers, fires started by lightning and natives were one of the most impor-



tant abiotic factors that sustained grassland ecosystems (Daubenmire 1968). Grass fires common over large areas each spring removed accumulated litter, sped nutrient cycling and killed woody plants, preventing their invasion of grasslands. Newly sprouted grass that follows burning has a higher nutritional value than older foliage (Daubenmire 1968) and likely benefited phytophagous insects as it did the large ungulates. The cessation of annual fires allowed trees to take root in sheltered, well-watered coulees.

Early farmers subscribed to the view of the Saskatchewan government that ‘the first task of the farmer is to destroy native plants in order to prepare a place for cultivated plants to grow’. Farmers quickly plowed under the original flora of the prairies and replaced it with plants of Eurasian steppe origin. Highly diverse grassland ecosystems were turned into agroecosystems of low biodiversity with the planting of wheat, oats, barley, rye, corn, alfalfa, canola, sugar beet, etc. The cereals were related to the native grasses and as a result many species of

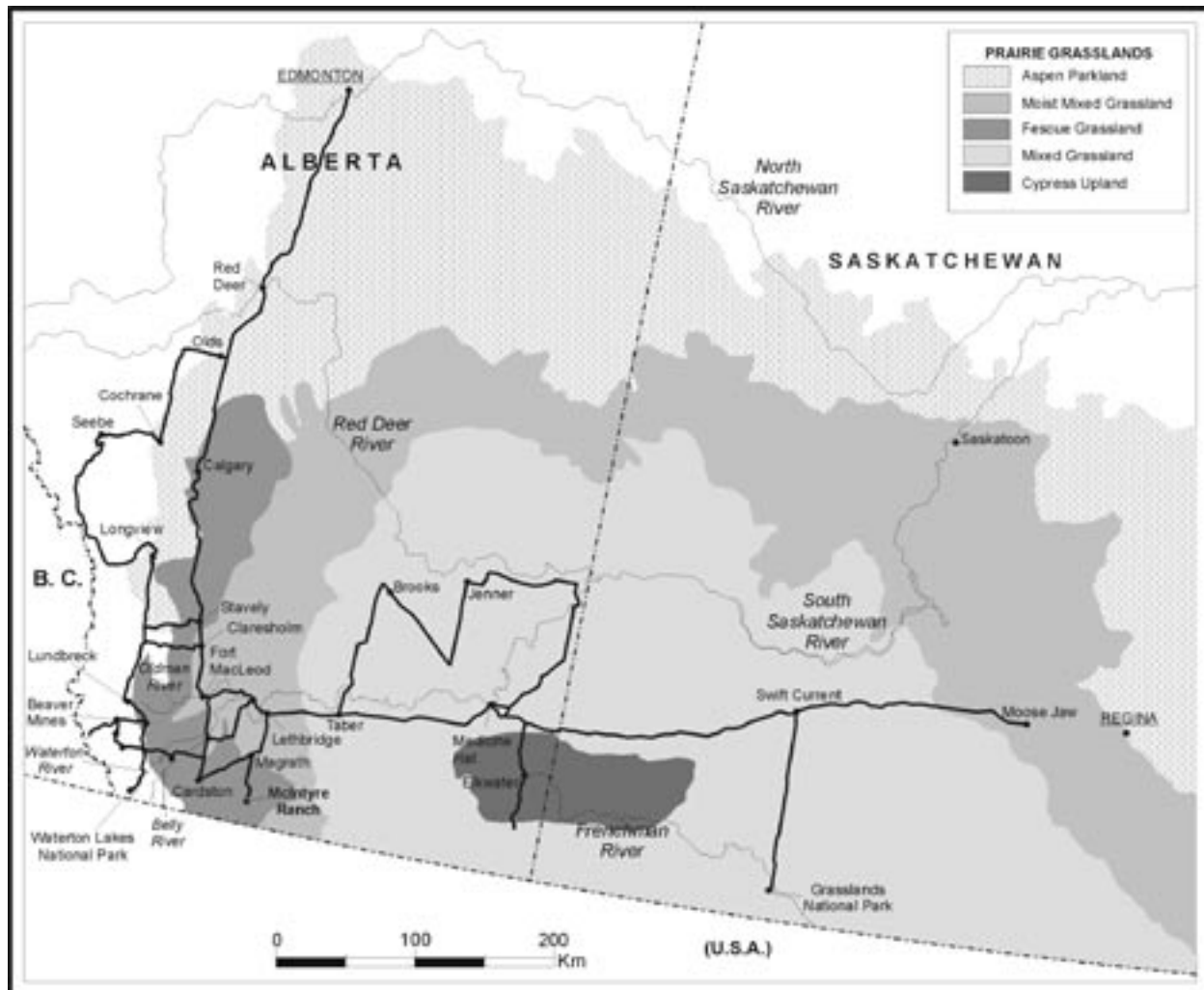


Fig. 1. Map of southern Alberta and Saskatchewan showing route of 2002 trip.



endemic insects, such as grasshoppers, wireworms and cutworms, were able to switch with ease from endemic grasses to cereal crops.

Ploughing the sod led to a loss of crumb structure of the soil, compaction and reduced ability to absorb moisture and, as a result, increased potential for wind erosion. Altered structure and atypical exposure to sunlight, especially in years of summer fallow, has had a predictable effect on soil fauna (Behan-Pelletier 1999). Sloughs and wetlands were drained or converted to agricultural lands such that today about 70% of the prairie wetlands and sloughs have been drained to provide additional agricultural lands. Later, dams were built on prairie rivers to form reservoirs from which irrigation canals were constructed to carry water to agricultural fields.

Farmers also introduced plants such as caragana (*Caragana arborescens*), lilac (*Syringa vulgaris*), Russian wild rye grass (*Elymus junceus*), crested wheat grass (*Agropyron cristatum*) and smooth brome (*Bromus inermis*) from Asia. Crested wheat grass was introduced in 1915 from Siberia (Looman 1983) to reduce wind erosion and became an important food for cattle (Gray 1978).

Unfortunately, many species of unwanted European and Asian plants were inadvertently introduced to the prairies along with the seeds of crop plants. Weeds such as Canada thistle (*Cirsium arvense*) accompanied emigrants to the prairies, initiating a chain of weed infestation that has not been broken to this day. Some of the intentionally introduced species have become invasive such as crested wheat grass and smooth brome which invades roadside ditches and riparian zones. Plants such as Canada thistle, Russian knapweed (*Acroptilon repens*), leafy spurge (*Euphorbia esula*), wild oats (*Avena fatua*) and stinkweed (*Thlaspi arvense*) became noxious weeds that have not yet been controlled.

The advent of crop-eating insects and weeds competing with crops led to the widespread use of insecticides and herbicides, and the need to enhance crop productivity led to the widespread use of fertilizers. Copious amounts of insecticides, herbicides and fertilizers are still used today.

## Route of the 2002 trip

To cover as much of southern Alberta and southwestern Saskatchewan as possible (see Fig. 1 for map of route) and still have time to explore and sample various habitats, most travelling was done on highways, but with frequent excursions down side roads. The trip started in Edmonton and proceeded south through crop and pasture lands that were once aspen parkland; however, areas can still be found where aspen are being cut and burned to expand agricultural lands (Fig. 2). Fescue grasslands in the foothills west of Calgary were explored and a large herd of bison (Fig. 3) was observed in a valley north of the trans-Canada highway in a habitat likely similar to that once occupied by wild herds about 125 years ago. Natural appearing fescue pasturelands with dense stands of grasses and herbs were examined in the Porcupine Hills west of Stavely and Claresholm that are now inhabited by cattle (Fig. 4) rather than bison. Fescue grasslands here would be ideal for biodiversity studies as are fescue grasslands on glacial deposits on the eastern slopes of mountains in Waterton National Park (Fig. 5).

Most of the major rivers in southwestern Alberta including the Old Man, St. Mary's and Waterton have been dammed to store water for irrigation purposes. The Waterton reservoir (Fig. 6) north east of Waterton National Park was next examined as were irrigation ditches (Fig. 7) with waters from the Old Man and St. Mary's reservoirs. The Blood Indian Reserve was traversed through Standoff where much land is still in a natural state (Fig. 8), and ideal for biodiversity studies. This site, along with others examined north east of Medicine Hat (see below), would be ideal for contrasting insect biodiversity found in typical fields of cereals (Fig. 9).

Most of the valley along the banks of the Old Man River from Fort MacLeod to Medicine Hat remains relatively pristine. In many areas flood plains have been broken for agriculture, but there are still vast areas of natural grasslands on the coulee sides and surrounding the broken lands. One site north east of Coaldale had thick patches of roses between



Fig. 2. Aspen parkland being removed to expand agricultural lands.



Fig. 3. Herd of bison on fescue grasslands west of Calgary, Alberta.



Fig. 4. Cattle on fescue grasslands west of Longview, Alberta.



Fig. 5. Natural fescue grasslands on the eastern side of Waterton Lakes National Park.



Fig. 6. Irrigation reservoir on the Waterton River north east of Waterton Lakes National Park.



Fig. 7. A typical example of the irrigation ditches which are temporary streams across the dry prairies.



Fig. 8. Natural grasslands on the Blood Indian Reserve east of Standoff, Alberta.



Fig. 9. Monoculture of wheat north east of Coaldale, Alberta



Fig. 10. Flood plain, with poplars along the water's edge, in the deep valley of the Old Man River north east of Coaldale, Alberta.



Fig. 11. Natural fescue grasslands on the McIntyre Ranch south of Magrath, Alberta.



Fig. 12. Dry mixed grassland north of Medicine Hat, Alberta.



Fig. 13. Carabid beetle *Euryderus grossus* feeding on crested wheatgrass north east of Medicine Hat, Alberta.



the agricultural lands on the floodplain and the poplars growing along the river's edge (Fig. 10).

Much of the fescue grasslands south of Lethbridge have been broken for crop production; however, an exception is the vast McIntyre Ranch south of Magrath. This huge ranch of approximately 22,680 hectares is one of the largest unbroken tracts of fescue grasslands in southern Alberta and, other than bison being replaced by cattle, it is likely ecologically similar to its condition 150 years ago (Fig. 11). Some studies of insect biodiversity have been undertaken on the ranch (Finnamore 1996), but the possibility of making further studies should be explored.

The portion of the trip from Medicine Hat north to the Red Deer River traverses substantial amounts of very dry, mixed grass prairie (Fig. 12). The east-west road through the all but abandoned town of Buffalo adjoins the Red Deer River, which like the South Saskatchewan holds much promise for biodiversity studies along the lush river 'oases' in an otherwise very dry landscape. The road west through Buffalo to Jenner and then south encircles the vast Canadian Forces Base Suffield which contains some of the largest tracts of unbroken lands in western Canada. The area has received some study by entomologists (Finnamore 1998; Finnamore and Buckle 1999), but warrants much more attention.

One evening just before sundown, we drove along side roads about 10 km north east of Medicine Hat near the South Saskatchewan river and were amazed to see hundreds of adults of the carabid beetle *Euryderus grossus* feeding on the seed heads of roadside crested wheat grass (Fig. 13). The beetles were so common they could readily be seen from the car and literally handfuls were collected in a few minutes of sweeping. Most beetles were about 40-50 cm from the ground and would rapidly run down the stalks of grass when approached.

Like the Red Deer, Old Man and South Saskatchewan Rivers, the Cypress Hills in southeastern Alberta and southwestern Saskatchewan are 'oases' surrounded by dry lands. They are like lush islands rising 600 m above the flat-lying prairies that surround them and hold much promise for zoo-

geographic studies. Submontane fescue prairie occurs on the side of the hills and on the slopes at the upper elevations there is a mix of lodgepole pine, white spruce (Fig. 14) and aspen. The hills are composed of coarse gravel that was deposited 44 to 35 million years ago and they stood above the glaciers like nunataks during the last ice age (Acton et al. 1998). There is fescue prairie grassland on the plateau.



Fig. 14. North slope of the Cypress Hills in southeastern Alberta with thick forest of white spruce.

The terrain between Medicine Hat, Alberta and Moose Jaw, Saskatchewan, which is through the centre of the mixed grasslands and Palliser's Triangle, is a mixture of semi-natural grasslands, crops lands and pastures. There is also an interesting range of wetland types from small potholes (Fig. 15) to shallow eutrophic lakes and saline lakes (Fig. 16) that are ideal for studying habitat preference by aquatic invertebrates.



Fig. 15. Small prairie pond north of Mortlach, Saskatchewan.



Fig. 16. Saline Chaplin Lake west of Moose Jaw, Saskatchewan.

The Grasslands National Park, the only Canadian park in grasslands, contains lands that have been grazed by cattle but not broken. The Park is one of the most ideal sites in southern Saskatchewan for intensive studies of invertebrate biodiversity and parks officials are anxious to facilitate such studies. Park officials are attempting to return much of the park to its natural state, which is a daunting task because of the presence of so many exotic species. As in most other regions of the grasslands, crested wheat grass monopolizes roadside ditches and efforts are being made to remove the species by a variety of means, including the spraying of herbicides (Fig. 17).



Fig. 17. Spraying herbicide on crested wheat grass in the Grasslands National Park.

### Concluding thoughts

Sections of pristine grassland still exist in many parts of southern Alberta and Saskatchewan; however, they are isolated and likely impacted somewhat by exotic plants and invertebrates. We will never know whether or not these remaining sites and the assemblages they support today resemble those present prior to settlement by Europeans. Few species of prairie insects have likely become extinct because of settlement, but many will have been reduced to small populations inhabiting scattered refuges.

A challenge for entomologists will be to illustrate and compare the biodiversity within these refuges throughout the grasslands biome, both on the prairies and elsewhere, and to show how their sustainability is dependent upon diverse assemblages of insects. It is expected that such studies will show how agriculture benefits by having insect assemblages adjoining crop and pasture lands.

There is particular need for more intensive studies of invertebrate biodiversity in unique prairie habitats such as those along the banks of river valleys and elevated lands such as the Milk River Ridge and Porcupine and Cypress Hills. As well, comparative studies of aquatic fauna in the now sparse prairie potholes and sloughs, from the fescue grasslands of southwestern Alberta east across the mixed grass and moist mixed grass ecosystems to southern Manitoba, would be particularly rewarding. As well, comparisons of invertebrate fauna in streams, rivers, irrigation ditches and reservoirs would illustrate the extent to which human activities have altered these systems.

Canada's international obligations require us to catalogue, monitor and protect the flora and fauna within our borders. Consequently, there is an urgent need to survey the biodiversity of prairie arthropods, the majority of which play as yet undiscovered roles in grassland ecosystems. Protecting the remaining tracts and remnants of Canada's prairie grasslands is important as efforts intensify to conserve ecosystems and the species they contain.



## Acknowledgements

I thank Léo Larivière of the Department of Geography of Laurentian University for drawing the map and my wife Marilyn for her willingness to accompany me through thick stands of prairie roses.

## References

- Acton, D.F., G.A. Padbury and C.T. Stushnoff. 1998. The ecoregions of Saskatchewan. Canadian Plains Research Center, University of Regina, Regina, Sask.
- Archibold, O.W. and M.R. Wilson. 1980. The natural vegetation of Saskatchewan prior to agricultural settlement. *Canadian Journal of Botany* 58: 2031-2042.
- Behan-Pelletier, V.M. 1999. Oribatid mite biodiversity in agroecosystems: role for bioindication. *Agriculture, Ecosystems & Environment* 74(1-3): 411-423.
- Daubenmire, R. 1968. Ecology of fire in grasslands. *Advanced Ecology Research* 5: 209-266.
- Finnamore, A.T. 1992. Arid grasslands - biodiversity, human society, and climate change. Quantifying biotic responses associated with anthropogenic change, a prerequisite for interpreting biotic shifts in long-term climate change research. *Canadian Biodiversity* 2: 15-23.
- Finnamore, A.T. 1996. The aculeate wasps with the exception of the Formicidae (Hymenoptera: Chrysidoidea, Vespoidea, Apoidea: Spheciformes) of the McIntyre Ranch in the grasslands of southern Alberta. pp. 65-80 in W.B. McGillivray and M. Steinhilber (Eds), *A bioinventory of McIntyre Ranch: An extensive fescue-dominated grassland in southern Alberta*. Natural History Occasional Paper No. 22. Provincial Museum of Alberta, Edmonton, Alta.
- Finnamore, A.T. 1988. Results from grasslands: aculeate wasps from Canadian Forces Base Suffield (Hymenoptera: Chrysididae, Vespoidea, and Apoidea: Sphecidae). *Newsletter of the Biological Survey of Canada (Terrestrial Arthropods)* 17: 44-57.
- Finnamore, A.T. and D. Buckle. 1999. Arthropod component report. The stinging wasps (Hymenoptera: Chrysidoidea, Vespoidea, Apoidea) and spiders (Araneae). Canadian Forces Base Suffield National Wildlife Area. Wildlife Inventory. Provincial Museum of Alberta, Edmonton, Alta. 197 pp.
- Foster, J.E. 1994. The Metis and the end of the plains buffalo in Alberta. pp. 61-77 in J.E. Foster, D. Harrison and I.S. MacLaren (Eds), *Buffalo*. University of Alberta Press, Edmonton, Alta.
- Foster, J.E., D. Harrison and I.S. MacLaren. 1994. *Buffalo*. University of Alberta Press, Edmonton, Alta.
- Gray, J.H. 1978. *Men Against the Desert*. Western Producer Prairie Books, Saskatoon, Sask.
- Knapp, A.K., J.M. Blair, J.M. Briggs, S.L. Collins, D.C. Hartnett, L.C. Johnson and E.G. Towne. 1999. The keystone role of bison in North American tallgrass prairie. *BioScience* 49: 39-50.
- Looman, J. 1983. 111 range and forage plants of the Canadian prairies. Agriculture Canada Research Branch Publication 1751.
- Peltzer, D.A. 2000. Ecology and ecosystem functions of native prairie and tame grasslands in the northern Great Plains. pp. 59-72 in T.A. Radenbaugh and P.C. Douaud (Eds), *Changing Prairie Landscapes*. Canadian Plains Research Centre, Regina, Sask.
- Radenbaugh, T.A. and P.C. Douaud (Eds). 2000. *Changing prairie landscapes*. Canadian Plains Research Center, University of Regina, Regina, Sask.
- Potyondi, B. 1995. In *Palliser's Triangle: Living in the Grasslands 1850-1930*. Purich Publishing, Saskatoon, Sask.
- Turnbull, A.L. 1979. Recent changes to the insect fauna of Canada. pp. 180-194 in H.V. Danks (Ed.), *Canada and its insect fauna*. *Memoirs of the Entomological Society of Canada* 108.

[All photographs in this article provided by the author.]



Canada